Client briefing

JULY 2012

Carbon pricing in the NEM: Day One

The long debate surrounding carbon pricing in Australia entered a new phase on Sunday, 1 July with the commencement of Australia's carbon pricing scheme at a $23/tonne CO_2-e starting price. Based on the first day of volume-weighted average pool prices across New South Wales, Queensland and Victoria, the introduction of a carbon price has lead to a roughly $23/MWh increase in pool prices. This reflects a rate of carbon price pass-through into wholesale pool prices of approximately 100%, and an average pool price increase due to carbon of 66%.

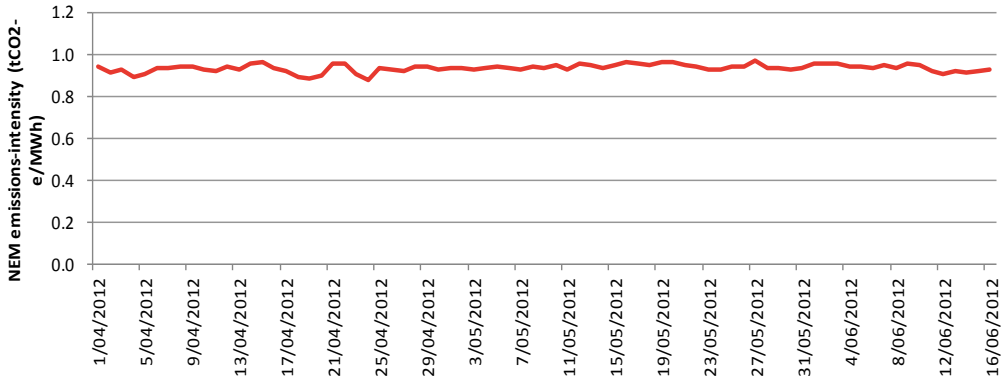
THEORETICAL EXPECTATION OF IMPACT ON POOL PRICES

Simple economic theory suggests that the introduction of a carbon price should result in generators incorporating the carbon cost they face in generating a megawatt hour of electricity in the prices at which they offer to generate electricity in the wholesale electricity market. The carbon cost incurred in generating a megawatt hour of electricity becomes part of the marginal cost of electricity production, much like the cost of gas or coal. The size of the per megawatt hour carbon cost a generator faces is determined by its emissions intensity: brown coal generators have the highest emissions intensity of all

generation sources and as such are expected to face the largest $/MWh carbon impost, followed by black coal and then gas generators.

Across the National Electricity Market (NEM), the average emissions intensity is presently just over 0.9 tonnes of CO_2 emissions per megawatt hour generated (see chart below). This means that, at least initially, the level of carbon price pass-through into wholesale electricity prices is likely to be quite high – close to 100%. This means that a $23/tonne carbon price should result in a near one-for-one (i.e. near-$23/MWh) increase in wholesale electricity prices.

High rates of carbon price pass-through are expected initially because the stock of existing generation capacity is fixed over short to medium term. This means there is limited opportunity to substitute away from relatively high emissions-intensive generation to relatively low emissions-intensive generation. Over time, as less emissions-intensive plant are developed in response to the carbon price, the extent of pass-through should fall. However, if new lower emission plants are not built because of, say, uncertainty over the longevity of the carbon price, then pass through rates will remain high and the carbon price will have little effect on the level of emissions from the generation sector. In this case the carbon tax is just a tax and will do little to lower carbon emissions in Australia. This is the more likely scenario.



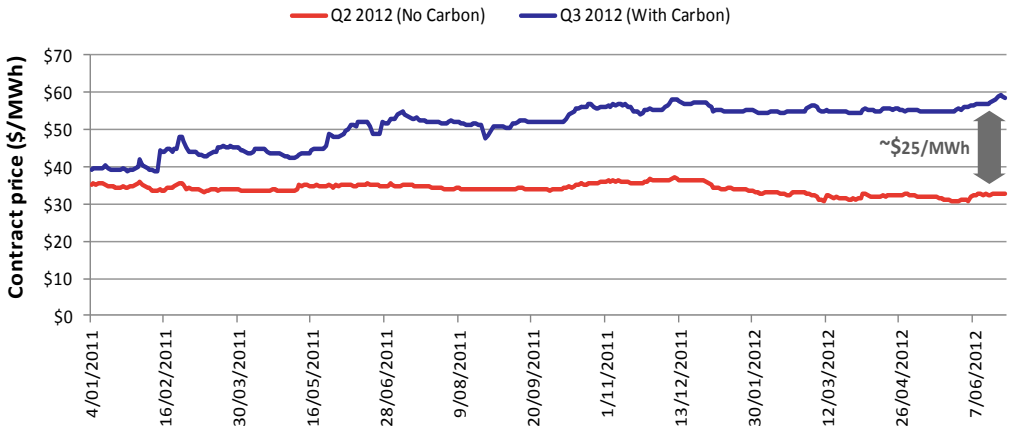
Source: AEMO NEM Carbon Dioxide Equivalent Intensity Index (CDEII)

MARKET EXPECTATION OF IMPACT ON POOL PRICES

For well over a year, futures markets have anticipated the introduction of a carbon price from 1 July. While the timing and initial price have at times been prone to policy uncertainty, since around March 2011 electricity futures markets have been pricing in a more-and-more certain 'carbon price premium'.

This premium reflects the market's expectation of the impact that a $23/tonne price on carbon is expected to have on the market price for a megawatt hour of electricity generated in the NEM. Based on the latest traded prices of New South Wales baseload futures (comparing Q2 contracts which exclude carbon to Q3 contracts which include carbon), the market's expectation of a $23/tonne carbon

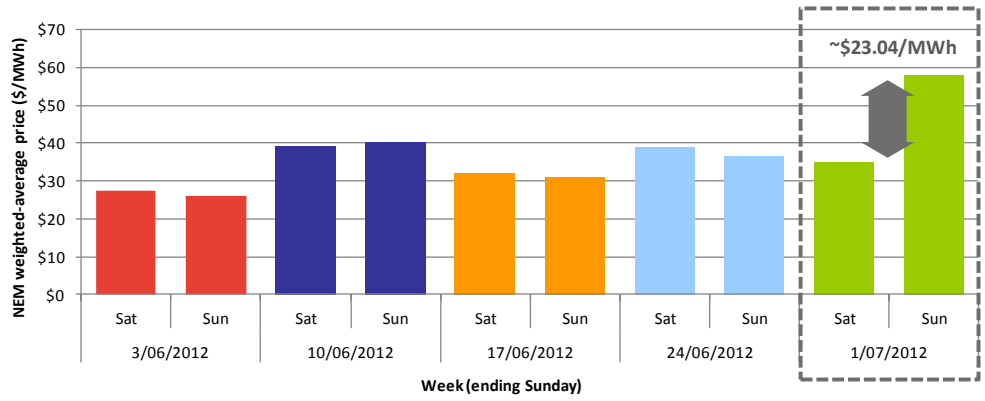
price is an increase in wholesale electricity prices of roughly $20/MWh[1] (see chart below), which reflects a level of carbon price pass-through of just under 90%.



Source: d-cyphaTrade contract prices

ACTUAL IMPACT ON POOL PRICES

Both economic theory and electricity futures markets indicate that a relatively large proportion of the carbon price will be passed through into higher wholesale electricity prices, at least initially. Based on the first day of market trading with a carbon price of $23/tonne this expectation has held true.



Source: Frontier Economics analysis of AEMO NEM price data

Comparing the past 4 weeks' of pre-carbon volume-weighted average prices across New South Wales, Queensland and Victoria[2] on Saturdays and Sundays

[1] Historically Q3 contracts have traded at a slight premium to Q2 contracts due to cooler temperatures and hence higher expected demand and pool prices in Q3. This difference has historically been on the order of $5/MWh. The price difference between Q3 2012 contracts (carbon inclusive) and Q2 2012 contracts (carbon exclusive) has been around $25/MWh for the past few months. This implies that carbon is responsible for roughly $20/MWh of this premium.

indicates that the price difference is generally less than $2/MWh between these days of the week. However, comparing the average price difference between Saturday 30 June and Sunday 1 July reveals a $23.04/MWh difference. This difference is overwhelmingly[3] a direct impact of the carbon price.

Inferring that the direct increase in wholesale pool prices from the introduction of a $23/tonne carbon tax on the first day of trading was $23.04/MWh, average carbon pass-through across the New South Wales, Queensland and Victorian regions of the NEM on the first day of carbon pricing is estimated at 100.2%. The increase in the average daily pool price from the introduction of a carbon price is estimated to be 66%.

ANALYSIS OF GENERATOR BIDS

The uplift in wholesale pool prices experienced on 1 July is a direct result of generators in the NEM reflecting the marginal carbon cost they now face in generating a megawatt hour of electricity in the prices they offer to the market operator.

The bid curves of three baseload coal generators – one each located in Victoria (Hazelwood), New South Wales (Mt Piper) and Queensland (Kogan Creek) – are outlined in the chart below. The chart shows the proportion of generation capacity (horizontal axis) that each generator has offered at various $/MWh prices (vertical axis) during the 5-minute dispatch interval ending 18:30[4] on five recent Sundays:

- The blue lines show bids on the last 4 Sundays in June which exclude carbon.
- The red line shows bids on the first day of carbon pricing on Sunday 1 July.

Bids between $0/MWh and $100/MWh are highlighted. All bids are shown for Sundays within a one month window to control for different demand conditions that can occur across different days of the week and times of the year.

The bid curves indicate several interesting patterns. First and foremost (and as expected) bids have been increased to reflect the marginal cost of carbon faced. In a competitive market, the degree of expected uplift to a given generator's bids is determined by that generator's emissions-intensity of electricity production.

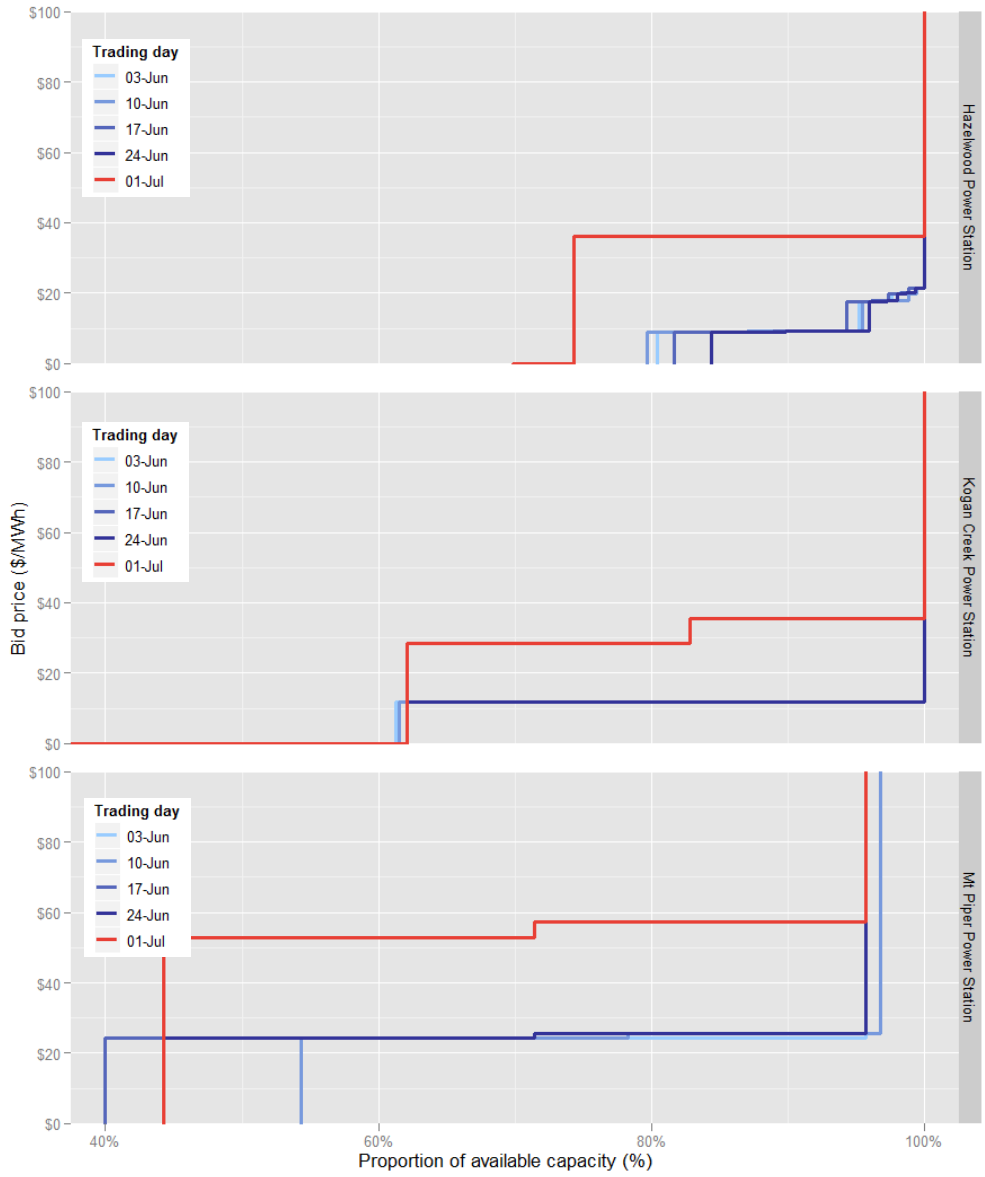
---

2 We exclude South Australia and Tasmania to control for unusual climatic factors that lead to irregular prices over the period of interest.

3 It is not possible to say with certainty that this price difference is purely due to the impact of a carbon price. Based on historical price differences between Saturdays and Sundays and the broadly similar demand conditions that prevailed on 30 June and 1 July it is possible to say with a very high level of confidence that the large majority of this price increase is due to the carbon price.

4 The dispatch interval ending 18:30 has been the peak demand interval across the majority of NEM regions on these days.

For the three generators outlined above, Hazelwood has the highest emissions-intensity (~1.53 tCO_2-e/MWh) and so would be expected to increase its bids by the largest degree. This is followed by Mt Piper (~0.94 tCO_2-e/MWh) and finally Kogan Creek (~0.92 tCO_2-e/MWh).



Source: Frontier Economics analysis of AEMO bid data

Closer inspection of the bid curves reveals that:

- Hazelwood has increased its bids in the 80-90% capacity range by around $27/MWh (from just under $10/MWh to just over $36/MWh). This is less than their expected marginal carbon cost[5] of around $35/MWh.
- Kogan Creek has increased its bids by between $17/MWh and $24/MWh. This range is consistent with their estimated marginal carbon cost of $21/MWh.
- Mt Piper has increased its bids by between $28/MWh and $32/MWh. This is more than their expected marginal carbon cost of around $22/MWh.

Finally, while not visible on the above chart it is also interesting to observe how bids at much higher prices have changed. In all cases the bids submitted to the market operator in the highest price band have increased by considerably more than the expected cost of carbon – the highest-priced bids have increased on the order of $220-$450/MWh, as compared to a (maximum) expected cost increase due to the carbon price of around $40/MWh. It should be noted that due to mild demand conditions the generators submitting these bids would not have expected that this capacity would have been involved in setting pool prices on the day.

CONCLUSIONS

Both simple economic theory and electricity futures markets have pointed towards a very large proportion of the carbon price being passed through into wholesale electricity prices at the commencement of a carbon pricing scheme in Australia.

Based on daily average pool prices on the first day of carbon pricing this expectation has held true. We estimate that the $23/tonne carbon price was passed-through at just over 100% on the first day of trading in the NEM, resulting in an estimated increase in the daily average price across New South Wales, Queensland and Victorian of $23.04/MWh. The $23.04/MWh increase in the daily average pool price reflects a 66% increase due to the carbon price.

5 Marginal carbon cost is calculated as the prevailing carbon price multiplied by the emissions-intensity of the generator.

CONTACT	**James Allan** james.allan@frontier-economics.com
	Liam Blanckenberg liam.blanckenberg@frontier-economics.com
	Frontier Economics Pty Ltd
	FRONTIER ECONOMICS MELBOURNE | SYDNEY | EUROPE
	www.frontier-economics.com